

A NEW SPECIES OF *PARAPHELINUS*, PERK., FROM BRITISH GUIANA,
WITH A DISCUSSION OF THE GENUS AND THE ALLIED
APHELINUS, DALM.

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During the past summer (1916) Mr. C. B. Williams has, on behalf of the Department of Agriculture, Trinidad, been engaged in investigating the natural enemies of *Tomaspis* and its allies, in the hopes of finding some effective means of controlling the froghopper, *Tomaspis saccharina*, Dist., which in recent years has caused considerable damage to the sugar plantations of Trinidad. With this object Mr. Williams has made collections of minute parasitic Hymenoptera in the Island and the adjacent mainland of British Guiana, and this material has from time to time been forwarded to me for study. Mr. Williams has from the first been fully alive to the importance of securing any specimens of the egg-destroying *Paraphelinus*, Perk., and I am glad to find species of this interesting genus in the gatherings from both Trinidad and British Guiana. The literature dealing with *Paraphelinus* is scattered and perhaps inaccessible to those to whom it is most likely to prove serviceable. I have therefore, in some introductory notes, recapitulated the main facts in the life-history and host attachment and added a bibliography to the present paper.

As an economic insect *Paraphelinus* owes its importance to the fact that while most APHELININAE attack Aphids, Coccids, and Aleurodids, this genus destroys the eggs of *Xiphidium* and *Tomaspis*. Although the genus is of comparatively recent erection, it is likely, as Dr. Perkins pointed out in his original description, that *Agonioneurus locustarum*, Giraud, bred from the eggs of a grasshopper, *Xiphidium fuscum*, is really a *Paraphelinus*. *P. xiphidii*, Perkins, is an efficient controller (Swezey, 2, 4) of *Xiphidium varipenne*, Swez. The parasite was first observed in March, 1905, in the grounds of the Hawaiian Sugar Planters Association's Experiment Station, Honolulu, where it had almost certainly been introduced.

The eggs of the *Xiphidium* are laid in clusters just beneath the leaf-sheath of the sugar-cane, where they are attacked by the parasite; 7-14 examples of *Paraphelinus* may emerge from a single egg and occasionally the whole cluster of eggs (2-15) is affected. Like many species of which several imagines emerge from a single host, all the individuals in a brood of *P. xiphidii* use the same hole of emergence, which is gnawed by the first to hatch out. The aperture is circular, and when the host egg is closely pressed against the leaf-sheath, the latter as well as the egg-shell may be gnawed through. If the *Xiphidium* egg is examined in balsam after the parasites have emerged, the empty pupal envelopes of the *Paraphelinus* may be seen, together with numerous darker granules within the shell. These granules are the accumulated foecal matter which is discharged by the insect shortly after emergence. Parasitised eggs are bluish-black in colour. The life-cycle of *Paraphelinus* varies from 20-31 days, that of the host being three months; the parasite is thus placed at a distinct advantage, and shortly after it was first noted, proof of its beneficial work was given by the rapid disappearance of *Xiphidium* in some districts.

About three years later Swezey (4) recorded a disconcerting departure from the usual habit of *Paraphelinus*. In February 1908, *P. xiphidii* was bred as a hyperparasite from cocoons of a Dryinid, *Haplogonatopus*, Perk.* Experiment showed that *Paraphelinus* reared from the Dryinid readily attacked *Xiphidium* eggs and the resulting imagines quite as freely reverted back to *Haplogonatopus*, attacking the larva just before it pupated. Whether the host was an egg or larva the number of *Paraphelinus* was the same, viz., 12 or 13 commonly.

Apparently *P. xiphidii* is a vigorous parasite, attacking whatever pabulum most conveniently offers itself; and the unfortunate feature of this particular case of hyperparasitism lies in the fact that it was desirable to protect the Dryinid because it destroyed leaf-hoppers. *Xiphidium varipenne* itself is partly a noxious insect, in so far as it attacks tender shoots, flower stamens, etc., and partly useful as a devourer of Aphids.

The material which I have had before me is as follows:—

- (a) A single female—"St. Clair, Trinidad; 12.iv.16; swept from grass" (C. B. Williams), which I have determined as *P. tomaspidis*, How. (see notes p. 56);
- (b) two lots of a distinct new species from British Guiana: (i) Issororo, N.W. Dist., 6.vii.1916, Lot 7, "Emerged from base of grass, *Imperata carinata*, containing *Tomaspis? carmodyi*" (C. B. Williams), 2 ♂♂, 8 ♀♀; (ii) ib. et id., Lot 8, during July 1916, 8 ♂♂, 26 ♀♀;
- (c) a slide containing a "parasitised egg of *Xiphidium* ♂ and 6 ♀♀ of *Paraphelinus*, Perkins"—Lahaina, Maui, 28. ix. 1905 (O. H. Swezey); possibly the seven examples referred to by Swezey (2, p. 215). This was generously placed at my disposal by Dr. Perkins to treat as might seem best. The seven examples have been remounted after careful potashing, the male and three females being partly or completely dissected. These preparations with others from Mr. Williams' material are deposited in the British Museum.

Only the most careful manipulation will produce satisfactory preparations of *Paraphelinus*. The wings may be detached from either dried or spirit material and mounted in the way already suggested (*Bull. Ent. Res.* vii, p. 231-2); but after potash and acetic acid, transference to oil should be gradually attempted. Three or four graduated layers from oil to absolute alcohol in a narrow 1 inch tube are not too many when dealing with such delicate organisms; the actual transference to absolute should be effected as quickly as possible, for even a momentary pause will permit the acid to evaporate and the preparation will be ruined. The object of having the specimen charged with acetic acid when passed into absolute is to regulate transfusion and to prevent collapse.

The slide of *P. xiphidii* was treated as follows:—The hard balsam at the edge having been removed, a little xylol was run round the cover slip; when the xylol had acted on the balsam for a short time two needle points were inserted a little apart and the cover broken by pressure between. In this way the cover was gradually chipped off without at any time bringing pressure to bear upon the brittle mounts.

* "*H. vitensis*. . . . No repetition of this hyperparasitism has since come to my notice."—O. H. SWEZEY, in litt., Dec. 1916.

It was interesting to find that after ten years the balsam had hardened only for a short distance from the edge. After being detached the specimens were thoroughly soaked in xylol and transferred to spirit, after which they were manipulated in the usual way.

External Morphology of Paraphelinus, Perk.

In the following account of *Paraphelinus* some notes of more than generic application have probably been included. The value of particular characters, whether tribal, generic, or specific, is at present very imperfectly understood in the Aphelinines. In particular, too little attention has been paid (*a*) to the clypeus and mouth-parts, especially the labrum, (*b*) to the sternal apophyses, and (*c*) to the general chaetotaxy; and in respect of these and some other features, I have tried to place the genus on a sounder basis.

Although the elongate facies, the antennae, and the head, distinguish the group at a glance, it is perhaps worth noting that one of its most striking features—the course and ending of the genal keel—might quite easily arise by an exaggeration of conditions obtaining in other allied genera. In the not very closely related *Cocophagus* group, *e.g.*, in some quite thin-headed forms, the keel is well forward, though the genae are normal. A little further shifting would cause the lower extremity of the keel to fuse with the sides of the clypeus and the condition found in *Paraphelinus* would result. Similarly the antennae with their distinctive “elbow” and terminal “horn” might result from an inconsiderable modification of the antenna in *Aphelinus* itself. The cumulative effect of such slight differences however is decided, and (apart from their host attachment) the species showing them form a compact genus.

The two known males are easily separated, but the females are extremely uniform, presenting differences of a rather critical nature. In discussing the antennae I state that 6 (7) joints are present; *i.e.*, of these six are obvious, but the first funicular has, I believe, the lamina or disc of the ring joint fused to it basally. With Perkins and Howard I assign the penultimate joint to the *funicle* and consider the last joint to be a solid club; Girault treats the penultimate as the first of a two-jointed club. In its natural position (seen best in a specimen mounted without pressure in a cell or under a supported cover-slip) the antennal “beak” curves gently outwards and the sense-organ appears in its normal position on the inner aspect. When, however, the antenna is mounted separately, the weight of the cover-slip, without distorting the general shape, brings the surfaces into the same or parallel planes, when the tip of the antenna appears to be decurved, and the sense-organ is dorsal. All the figures of the antenna have been drawn from this position. Besides the usual linear sensoria the club bears two peculiar organs each with a central stouter bristle (?); focussing down a little, these organs seem circular, but when the central bristle is distinct the surrounding rim is vaguer. The head is particularly difficult to examine, owing to the inequalities of surface it presents, and to its liability to collapse during the process of mounting. The chaetotaxy and shape of the clypeus may be made out in shrunken specimens, but notes on the proportions are worthless unless the head is naturally swollen.

In the thorax noteworthy features are the slight advance of the axillae, structure of the sternopleurae, etc. **One** peculiar abnormality of the dorsal chaetotaxy

deserves mention, viz., the very frequent failure of the second anterior medio-dorsal bristle on the *left* side of the mid lobe. The lateral ridges of the propodeon are really folds more or less internally strengthened. If preparations of *Paraphelinus* are made too quickly, the thin mid-dorsal region of the thorax is apt to collapse longitudinally, forming a more or less distinct furrow. This appearance can very easily be produced by plunging a specimen into oil after incomplete dehydration. Whether in life this line of weakness in the chitin has a sulcate appearance or not is uncertain, but I think the point worth mention, as Girault (6, p. 74) says of *Paraphelinus australiensis*, "There is a narrow median grooved line down the thorax." *P. speciosissimus*, Gir., is much more isolated, and it was hardly advisable to reconstruct the genus, as Mr. Girault (5) has done, from such a form. In four of the five described species the forewings are hyaline or faintly tinted, not conspicuously banded; the general coloration pale, *not* black and yellow; and the eyes hairy, *not* bare. Later Mr. Girault (9, p. 180) mistakenly, as it seems to me, sank *Paraphelinus*: "The forms named *Paraphelinus*, Perkins, intergrade with the forms of *Aphelinus*, Dalman, as the Australian species show, so that obviously there are not two genera represented by them. *Paraphelinus* must therefore fall as a true synonym of *Aphelinus*."

In *Aphelinus* (sens. str.), which preys upon various Aphids, the head is short and thin, normal, lenticular, with large eyes, behind which there is no temporal development. The occiput is sharply margined where it joins the vertex. The genal keel passes ventrally outside and behind the toruli; the clypeus is practically in the same plane as the frons, and its edge is straight. The mid lobe of the mesonotum is densely covered with short sharp bristles, the parapsides, which are deeply invaded by the axillae, bear 4 bristles. There are short, stout bristles on the metapleurae. The fore wings are triangular and the hind wings broad, with a short fringe; the abdominal tergites decrease in length posteriorly, and the ovipositor and its sheath are short. In all these characters *Aphelinus*, Dalm., offers a precise contrast to *Paraphelinus*, Perk.; and there are other differences, less obvious but equally important; e.g., in *Aphelinus* instead of a backward-sweeping parabolic incassation the pleurae show a short nearly verticle anterior rib. The prepectora are medianly fused and, in conjunction, band- or collar-like, reminding one of the genus *Coccophagus*, to which *Aphelinus* also approaches in its mandibles (cf. also the mesonotum). The genotype of *Aphelinus* is *A. abdominalis*, Dalm. (Svensk. Vet.-Akad. Handl., xli, p. 181, t. 8, f. 55, 56, 1820), of which *A. basalis*, Westw. (Ann. Nat. Hist., vi, p. 122, 1833) is, I believe, correctly regarded as a synonym. The foregoing remarks on the generic characters are based on an examination of two very old specimens of *A. basalis* in the British Museum Collection; one bears the data—"stood under this name in old B. M. Coll.—C. Waterhouse"; the other is labelled "*basalis*" in the handwriting of F. Walker, to whom the determination of both examples is due. The first is now completely dissected on two slides, the second mounted whole, except that the fore wings are under a separate cover-slip.

But while *Paraphelinus* is distinct from *Aphelinus*, it is closely approached by the small yellow-bodied group (at present placed in *Aphelinus*) which attack Coccids. Whether Perkins' genus should include the latter or not I cannot say; it is one of the Coccid-destroyers, *A. diaspidis*, How. (Ann. Rept. Dept. Agric., p. 355, 1880),

which Howard has figured as representative of Dalman's genus (U. S. Rept. Agric. Tech. Series, No. 1, p. 23, fig. 7, 1895).

Genus PARAPHELINUS, Perk.

♀ *Head* (fig. 1, *a, b, c*): In profile, long antero-posteriorly, the vertex, which hardly rises above the level of the eyes, being flattened, like the upper frons. Face inflated, widening ventrally and curving in sharply above the perpendicular clypeus; genal keel short; temples and genae swollen, the latter widening ventrally. Eye subtriangular, occupying about two-thirds of the depth, both upper angles broadly,

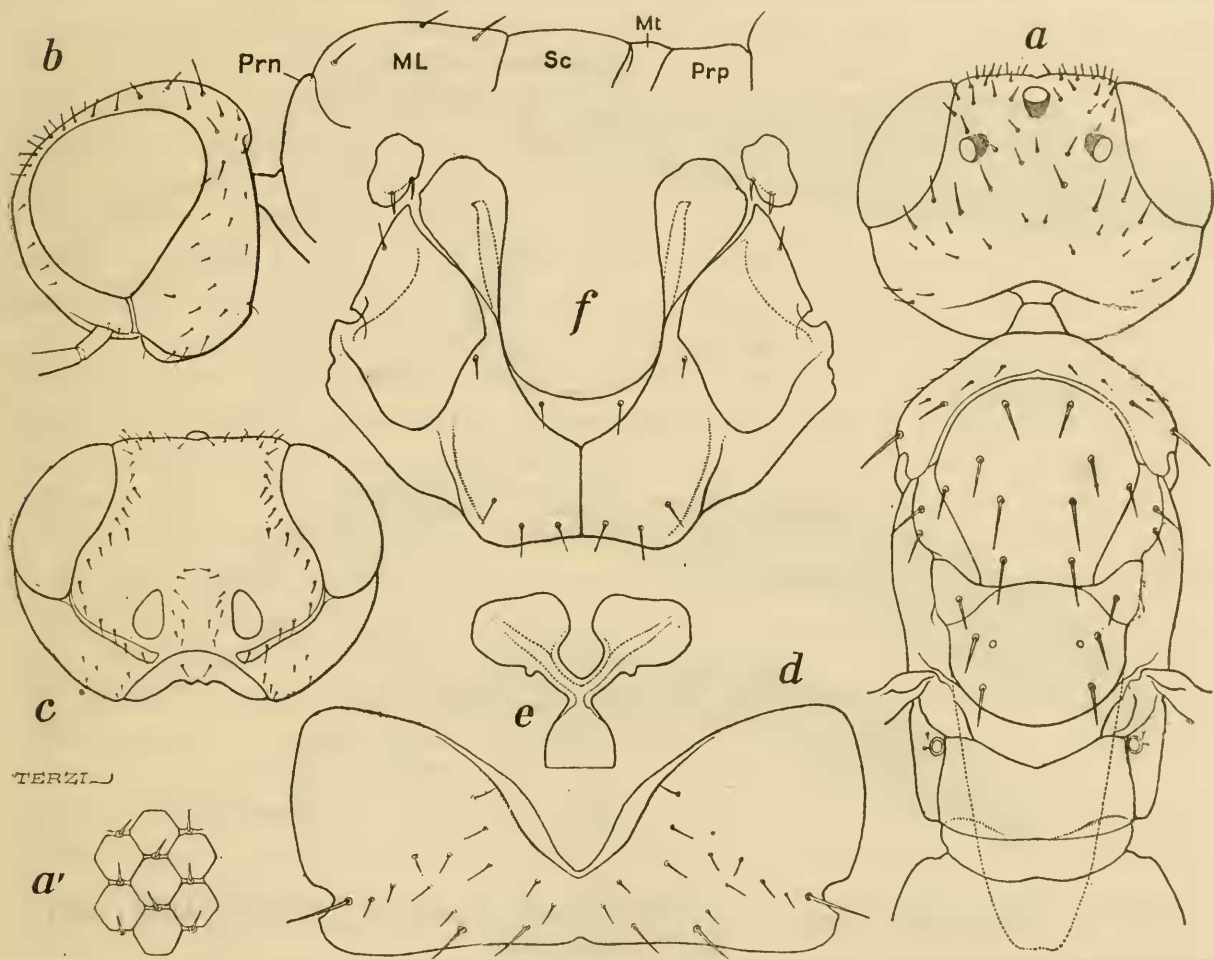


Fig. 1. *Paraphelinus xiphidii*, Perk., ♀: (*a*) head, thorax, and propodeon; (*b*) head, etc., in profile. *Paraphelinus perkinsi*, sp. n., ♀: (*c*) head, front view; (*d*) pronotum; (*e*) presternal apophysis; (*f*) mesosternopleurae—all flattened.

the lower angle hardly at all, rounded, set with numerous bristles arranged in straight rows. From above, the vertex is both broad and long, the orbits nearly parallel, but slightly divergent posteriorly; ocelli in a wide-angled triangle, the lateral pair about two diameters from the edge; supra-occipital edge broadly rounded; temples swollen distinctly backwards. From in front, the face proper contracts ventrally, the most remarkable feature of the head here being the running of the broad genal keel *forward* below the toruli to the upper angles of the clypeus, and the shortening

of the mouth-edge. The swollen out genae are carried forward beneath the toruli also, and are largely visible from in front. In the middle of the clypeus is a minute notch flanked on each side by a more or less distinct short lobe or tooth. The toruli are elongate, sub-triangular, broadest ventrally, with their adjacent sides sub-parallel.

Antennae (fig. 2), 6 (7)-jointed; scape, pedicel (ring-joint), three in funicle, club solid. Bulla long, apex of pedicel oblique, funicular joints gradually expanded. Second funicular joint set at an angle to the oblique apical dorsal surface of the first; second and third funicular in the same straight line, but the suture between them is more or less oblique. Third joint with one sensorium; club wider than last funicular, with several sensoria, and ending in a short outwardly curved beak. On

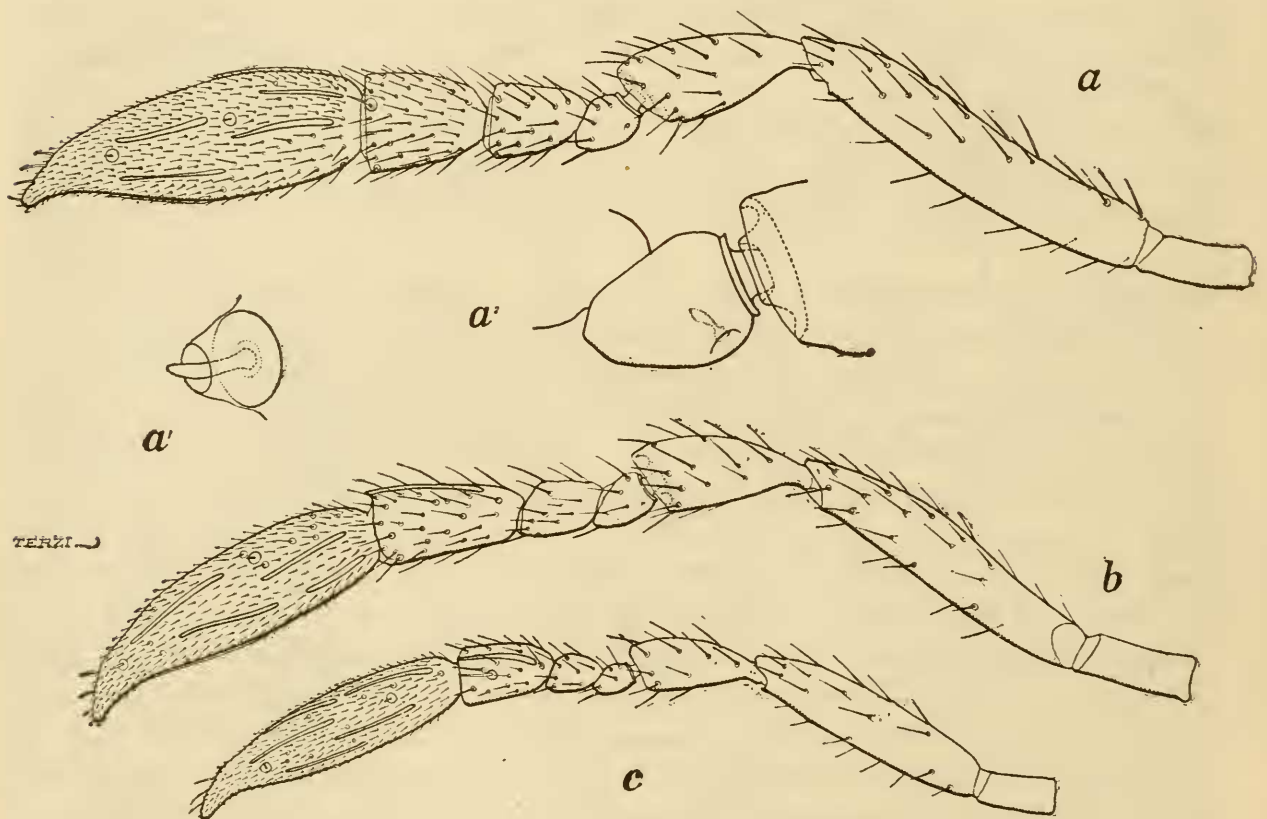


Fig. 2. Antennae of females of: (a) *Paraphelinus perkinsi*; (b) *P. xiphidii*; and (c) *P. tomaspidis*.

the inner apical aspect is a small sense-organ consisting of 4-5 sensory hyaline bristles, stouter than the elements of the general chaetotaxy of the antenna, standing above definite passages through the integument of the club.

Mouth-parts: Labrum triangular, apically rounded, with 2 central preapical bristles. Mandibles broad basally (8:7), tridentate. Trophi nearly circular; cardo small and narrow, stipes swollen and broad; maxillary palpus with the second joint sometimes presenting a false appearance of being divided in two; labial palpus longer than either joint of the maxillary; ligula with two median setigerous cells.

Thorax (fig. 1, a, b, d, e, f) flat dorsally; including the propodeon, half as long again as broad, widest at the level of the fore wings. The pleurae are very little

convergent towards the rounded, nearly rectangular, postero-lateral angles of the propodeon. The integument weakly chitinised and smooth or faintly patterned along a narrow middle line; the pattern beyond the middle line more raised towards the sides and the cells generally longer than broad. Pronotum descending, developed into two weakly connected triangular sclerites; when flattened, deeply emarginate anteriorly, straight posteriorly, the hind and lateral margins meeting in rather over a rounded right-angle, before which is the deep semicircular spiracular emargination. The longest and stoutest bristle is placed above the spiracle and there is always another fairly stout bristle before the edge half-way from the postero-lateral angle to the middle. Prosternum bare, rectangular, truncate posteriorly. Episternite large, with a minute bristle anteriorly and half a dozen on the anterior articulating projection. Mesonotum distinctly longer than the scutellum, mid-lobe large, the width at the anterior extreme of the parapsidal furrows about equal to the length; 10 stout coloured bristles in two widely separated rows (4 : 4) about the mid line and one inside each parapsidal furrow anteriorly. Side lobes narrow; two bristles on outer edge above the tegula, which also bears two bristles. The suture between the mid lobe and scutellum broad, a little curved antero-laterally where the small axillae (one bristle) shortly invade the rather narrow parapsides. Scutellum with 4 bristles (2 : 2), wider apart than those on the mid lobe. At the level of the anterior pair but a little nearer the mid line are a pair of clear pustules. Mesophragma long and narrow, reaching back to below the hind margin of the first abdominal segment. Metanotum and propodeon not carinate, but as both, especially the second, are declivous, about the mid line the latter shows up in a more or less distinct ridge. Metanotum band-like (the smooth lateral hollows small and shallow), present mainly as a broad short reticulated post-scutellum, which is widely angled over the propodeon. The latter as a rule nearly smooth, except medianly; two posteriorly slightly divergent faint lateral folds, so far apart as to be nearly in line with the sides of the abdomen. Beyond each fold there is a narrow triangular area with a short anterior sulcus; at the inner anterior angle lies the broadly oval moderate sized spiracle. Sternopleurae: sternum broader than long, pattern various, but rather large, very finely raised; two minute widely-spaced bristles on anterior edge, and 4 (one near each postero-lateral angle, and one on each side of the mid line) near posterior edge. Between sternum and pleura is a weakly defined edge, obliterated posteriorly (without internal support) and represented by a slight crease in flattened-out preparations. At the anterior end of this crease, and confluent with it for nearly half its length superiorly, there is a strong parabolic internal rib which, beginning at the antero-lateral sternal angle, sweeps backwards, enclosing about four-fifths of the pleural surface, and ends superiorly at the insertion of the forewing. The area thus enclosed is a little more prominent than the posterior (epimeral) region, which is delimited ventrally by a ridge, sloped from above the mid coxa diagonally towards the upper anterior pleural angle and fading out (at about one-fourth) in front of the parabolic rib already described. The pleural surface bears one minute bristle antero-ventrally. The episternite is indicated only by an internal chitinised suture. Prepectus large, antero-posteriorly striate, the cross reticulation nearly obsolete. The internal chitinous rib very near the hind edge. The metapleurae are absolutely bare.

Wings elongate, at least three times as long as broad, subspatulate in shape. Neuration reaching to one-half or just beyond, and very little bent at the junction of the marginal and submarginal. Submarginal cell narrow, with one minute bristle on the *upper* surface at one-third from the radix, and 2-4 apically. Submarginal vein with four short stiff bristles, one stronger on the marginal before that vein reaches the costa, 6-8 major bristles fringing marginal and postmarginal combined, while dorsally these veins bear 9-12 short appressed bristles. One bristle on radius, which is acutely inclined towards the costa. Basally the wing is narrowed, showing a few bristles below the submarginal. Across the wing, at the junction of the marginal and submarginal, is a sloped indistinct bare area, and another broad "hairless line," much better defined and roughly parallel to the first, crosses the wing from the end of the radius. This second track does not reach the posterior edge, before which one or two rows of the usual discal ciliation intervene. It is similarly cut off from the small clear spot outside the radius,

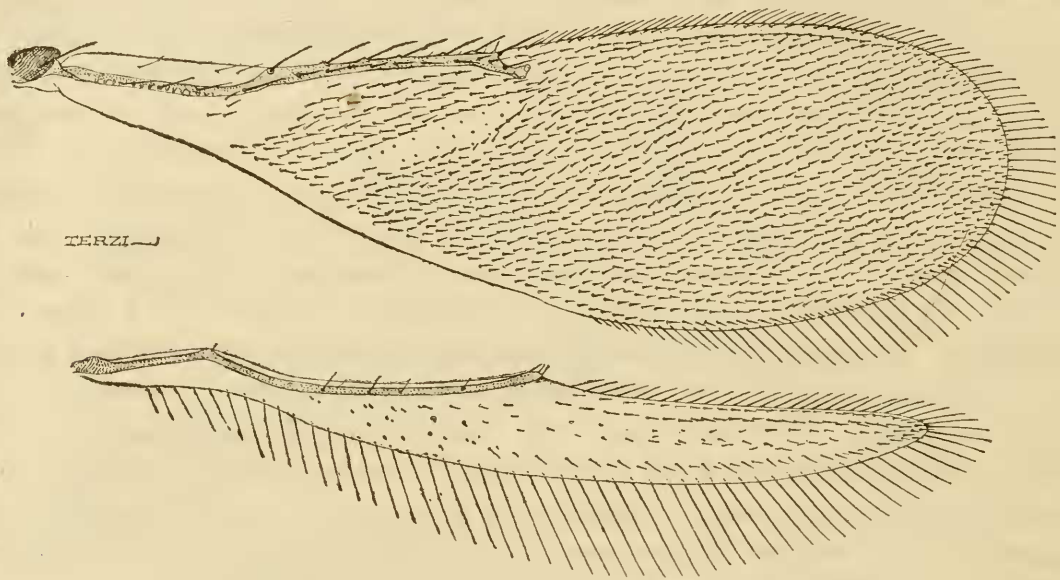


Fig. 3. *Paraphelinus xiphidii*, wings.

generally by one, sometimes by several, rows of bristles. The clear path shows scattered black dots, which are not the bases of broken-off bristles, but under an oil immersion are seen to be excessively minute prickles (rudimentary bristles?) set in the wing membrane. Beyond the bare track the discal ciliation is regular and dense, coming evenly up to the margin everywhere, but tending to form an isolated isoclinal row parallel to the costa on the apical half. Marginal cilia on costa very short and dense, sparser and longer apically, longest on the distal two-thirds of the hind margin and shortened again after the frenulum. *Hind wings* not much shorter than the fore wings, with no submarginal cell, narrowed basally and very elongate (up to eight times as long as broad). Posterior fringe long, equal to the extreme breadth (at the hooks). Costal fringe moderate. There is a row of minute bristles along the costa and a distinct isoclinal row subcostal in position. Discal ciliation otherwise sparse, varying specifically.

Legs. Fore legs: femur with no strong ventral bristles, except a (coloured) longer anterior one and a shorter (hyaline) posterior one, subapical in position;

tibia with the superior apical angle narrowed, chitinised, the apical comb hardly developed, with 2-3 spines. Mid legs: tibiae long, spur long and thin. Hind legs: coxae elongate, flat, oval; tibiae elongate, exceeding those of mid legs, spur short and not half the first tarsal joint. Tarsal proportions: in the fore legs the first and second tarsal joints are subequal (9:8), whilst in the mid and hind legs the first joint is much longer than the second (4:3); joints 3 and 5 are subequal in all the tarsi, 4 being a little shorter.

Abdomen elongate, acuminate, seen from above at least twice as long as broad, from the petiole to the base of the ovipositor sheath. Dorsal surface smooth, broadly in the middle, except for a narrow scaly reticulate band across the middle of the first tergite. Towards the side this band becomes normally reticulate, while at the extreme sides and on the overlaps of all the tergites the cells are drawn out antero-posteriorly. Posterior tergal edges straight, on 5 and 6 a little convex posteriorly. Tergites 1-5 equal, 6-7 longer. (The first tergite being anteriorly concave appears shorter, but at the sides it is even longer than its successors.) Sternites 1 and 5 are subequal and long, 2-4 much shorter and subequal.

Normal abdominal chaetotaxy:—

	I.	II.	III.	IV.	V.	VI.	VII.
Tergites ..	2, 2	2, 2	2, 2	3, 1, 3	8	2, 2	4, 4
Sternites ..	0	1, 1	1, 1	2, 2	6, 6	—	—

The bristles on tergites 1-3 are wide apart, one at the edge closely accompanied by the second. On tergite 5 the eight bristles form a continuous row with one in front and sometimes one behind at the sides. There are a few (3-5) minute post-spiracular bristles besides the longer transverse ones on tergite 6. The setigerous process on tergite 7 bears four bristles, one shorter. This tergite extends narrowly backwards above the base of the ovipositor sheath, but the bristles borne here are probably of specific value. On the fifth sternite the bristles are arranged 1, 2 and 3 on each side of the mid-line. The free portion of the sheath is rather long, and projects distinctly with the ovipositor.

Male similar to female. The antennal formula the same, with the scape flattened more or less. Wings shorter and broader. Fore legs a little stouter; second tarsal joint relatively shorter than in the female.

List of Species described in the Genus Paraphelinus, Perk., with Data of Host Attachment, original Collector, and Location of Type.

1. *P. xiphidii*, Perk. (1906) (l.c., p. 264, pl. xx, f. 6). From eggs of *Xiphidium varipenne*, Swez.; Hawaii (O. H. Swezey).

Type (female) in Mus. of Haw. Sug. Pl. Assn., Honolulu, Hawaii.

2. *P. speciosissimus*, Gir. (1911) (l.c., p. 181). Host unknown; Urbana, Illinois (A. A. Girault).

Type (female) in U. S. N. M., No. 14,122, Washington, D.C.

3. *P. australiensis*, Gir. (1913) (l.c., p. 74). Host unknown; Nelson, Queensland (A. A. Girault).

Type (female) in Queensland Museum, No. Hy. 1712, Brisbane.

4. *P. tomaspidis*, How. (1914) (l.c., p. 82). From eggs of *Tomaspis varia*; Trinidad (P. L. Guppy)

Type (female) in U. S. N. M., No. 18,321, Washington, D.C.

5. *P. perkinsi*, sp. n. From *Tomaspis*? *carmodyi*; British Guiana (C. B. Williams).

Type (female) in British Museum, London.

To the above should possibly be added *Agonioneurus locustarum*, Giraud (1), bred from eggs of *Xiphidium fuscum* in galls of *Lipara* spp. on *Arundo phragmitis* (Europe).

Since sinking *Paraphelinus*, Perkins, Mr. Girault has with extreme brevity described the undermentioned yellow or pale-coloured species of *Aphelinus* from Australia. In 1913 (9) the following:—*haeckeli*, *grotiusi*,* *darwinii*, *minutissimus*, *newtoni*; in 1915 (11) he added *miltoni** and *ruskini*. Of these the two asterisked species are probably referable to *Paraphelinus*, but only a re-examination of the types, which are deposited in the Queensland Museum, Brisbane, can enable one to place them exactly.

No remarks have been offered in the notes just given on the general coloration of *Paraphelinus*, but it is probable that the genus when more extensively collected and described will be found to include only pale forms like *perkinsi*, *xiphidii*, and *tomaspidis*. Detailed colour notes have been given only for the first of these. The infuscations of the abdomen, etc., are exceedingly faint, and when the body contents have been cleared away by potash the whole insect is perfectly transparent. Only in *xiphidii* are the genae distinctly darker; in *tomaspidis* they are faint. The wings in *xiphidii* and *perkinsi* are hyaline, in *tomaspidis* faintly embrowned. The following keys may serve to separate the species:—

Key to the Males of Paraphelinus, Perkins.

First two funicular joints very short and broad, the third elongate, cylindrical, nearly equal to the club, which bears the longest bristles of the antenna

xiphidii, Perk.

First two funicular joints normal, cylindrical, the third normal, two-thirds of the club, which bears the shortest hairs of the antenna

perkinsi, sp. n.

Key to the Females.

- 1 (2). Yellow and black species; forewings with a conspicuous median black band as wide as the marginal and stigmal veins *speciosissimus*, Gir.
- 2 (1). Concolorous, the head and thorax reddish yellow, abdominal tergites at most a little infuscated laterally; wings hyaline or uniformly faintly tinted.
- 3 (4). Deep orange yellow, immaculate; hind wing near tip with about 5 lines of discal cilia *australiensis*, Gir.
- 4 (3). Paler species; genae, metanotum and tergites of abdomen more or less infuscated.
- 5 (6). "Hairless line" of forewings incomplete on anterior half, with anteriorly convergent sides *tomaspidis*, How.
- 6 (5). "Hairless line" crossed at most by one or two lines of discal cilia at level of the radius knob, with sub-parallel sides.

- 7 (8). Club just longer than pedicel, third funicular joint about twice (5 : 3) as long as the second *xiphidii*, Perk.
- 8 (7). Club distinctly shorter than pedicel, third funicular not nearly twice (4 : 3) as long as the second *perkinsi*, sp n..

The following notes refer chiefly to the more minute specific differences between the females. It will be noted that the new species is more hirsute than the others. The males are so easily separated by the characters given in the key and figures that minor differences are not now described, but the dimensions of the antenna and wings have been stated. The legs of three of the species are compared in a concluding paragraph.

Paraphelinus xiphidii, Perk. (1906).

♀. *Head*: in profile (fig. 1, *b*) the vertex and upper frons are about four-fifths of the depth; where the frons is swollen out to its greatest extent the length and depth are about equal. On the gena the reticulation is drawn out, and there are 12–15 short scattered bristles up to the insertion of the episternites. From above (fig. 1, *a*) about one-half as long as broad, the proportions across the vertex at the posterior ocelli are 6 : 11, and in front of the anterior ocellus, where the eyes are nearest, 5 : 12; wider than thorax (22 : 19). Reticulation of vertex transverse, more regular anteriorly, three minute bristles in ocellar triangle with 2 (1 : 1) stronger ones between each pair of ocelli, the bristles close to the ocelli. Behind the posterior ocelli the vertex bears six stouter bristles (2, 2, 2), the middle pair in advance of the lateral pairs, and there are also 6–7 minute bristles at each side on the rounded edge above the temples. Between the orbits, a lateral and an anterior ocellus are 4–5 bristles. The frons bears along the orbits (between the keel and the level of the anterior ocellus) about a dozen bristles, the lowermost fine hyaline, 4–5 of the uppermost dark and stouter. Between each upper row of stronger bristles and the mid line are about 9 similar bristles (5, 4). The greater part of the face below is bare and faintly reticulate. Between and above the toruli 6–8 pairs of bristles, one pair above the clypeal edge and 3–4 (single) inside the genal keels.

Antenna (fig. 2, *b*): length, .37 mm.; bulla (3 : 1) over one-third (5 : 14) of the scape. Scape + bulla equal to pedicel + funicle. Pedicel just over half (23 : 42) the scape; 1st funicular (8 : 6), 2nd (12 : 7), 3rd (20 : 10), club (44 : 12). The club distinctly longer than the funicle (11 : 9), equal to (or if carefully measured, just longer than) the scape, and bearing 4–5 long sensoria. The scape with 4 ventral bristles, otherwise like *perkinsi*, except that there are only about a dozen bristles posteriorly.

Thorax: pronotum with the spiracular emargination occupying about two-ninths of the lateral edge; between each stout bristle on the posterior edge and the mid line are two weaker ones, 2–3 minute on each side of the mid line, and 6–8 obliquely across each half. Pattern everywhere distinct, traceable to the mid line. Mesonotum (14 : 15) half as long again as the scutellum (3 : 4). Mid sternal region distinctly separated from prepectus. Sternal pattern very faint but the cells large and sharply outlined when finely focussed.

Propodeon nearly twice as long as the metanotum (11 : 6) which is coarsely transversely reticulate; pattern very faint medianly, more distinct towards the lateral ridges. Spiracle circular, with two minute bristles at the outer edge of the rim.

Wings (fig. 3) about three and a third times as long as broad; length, .7 mm.; breadth, .21 mm. (excluding fringe). Hind wings over eight times as long as broad; length, .6 mm.; breadth, .07 mm. (excluding fringe); longest hairs of fringe as long as, or just exceeding the breadth.

Abdomen twice as long as thorax and propodeon, and nearly thrice as long as broad (8:3). The 7th tergite long and narrow, much longer (10:7) than the preceding (spiracular) tergite. The ovipositor does not exceed the sheath, which projects shortly (one-third the length of the seventh tergite), the free portion of the sheath being about one-half the base. Above the fixed part of the ovipositor sheath there are on

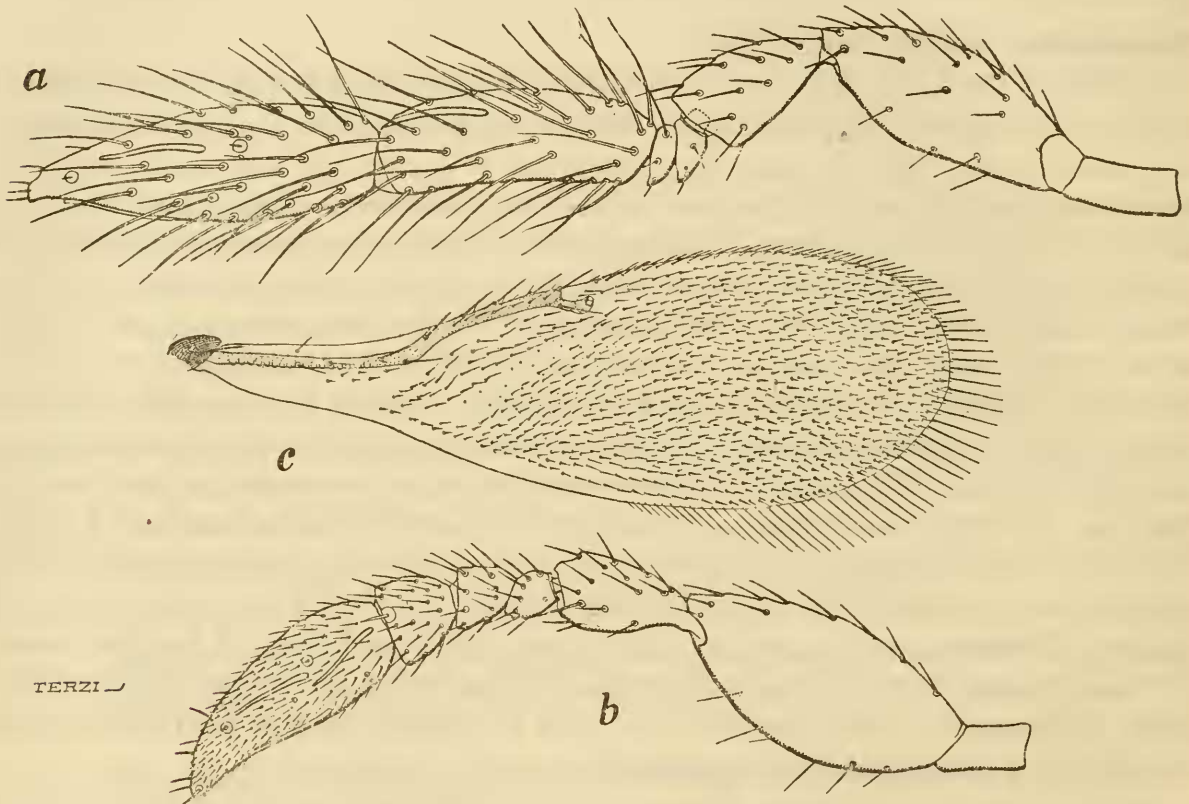


Fig. 4. *Paraphelinus xiphidii*, ♂: (a) antenna.
P. perkinsi, ♂: (b) antenna; (c) forewing.

the apical half about 4 longer bristles with 3 above placed below and behind the setigerous process; the free portion of the sheath bears a ventral row of 4-5 longer bristles with as many more (shorter) above and one or two (minute) at the apex.

Length, about 1 mm.; alar expanse, 1.6 mm.

♂.—Antenna (fig. 4, a): length, .37 mm. Forewings: length, .64 mm.; breadth, .2 mm. Hindwings: length, .54 mm.; breadth, .07 mm.

***Paraphelinus perkinsi*, sp. nov.**

Vertex, upper two-thirds of frons, eyes, and entire dorsal thoracic surface, pale rusty yellow; the dark inner chitinous socket of the eye shining through; ocelli, tips of mandibles, and ventral half of orbits (very narrowly) dark reddish brown; genae infuscated a little. Wings faintly tinted, veins hardly darker than the membrane. Otherwise colourless transparent, with the following marks: Anterior

tarsi faintly darker, all claws brown; sterno-pleural sutures narrowly darkly outlined, a pale median dorsal line from behind the head to above the ovipositor; pronotum and propodeon each with two or more or less defined triangular darker spots about the mid line. The tergites (except medianly) are faintly infuscated, so that the abdomen is indistinctly banded; on the 7th tergite (bearing the setigerous process) the band is darker, narrow, and distinct. Sternites a little infuscated; ovipositor reddish brown.

♀. *Head* from in front (7 : 6); frons narrowest ($\frac{2}{5}$ of the width) at two-thirds above the clypeal edge. Toruli well below the base-line of the eyes, three-fourths their own length from the mouth-opening and nearly twice (11 : 6) their length apart. Pattern

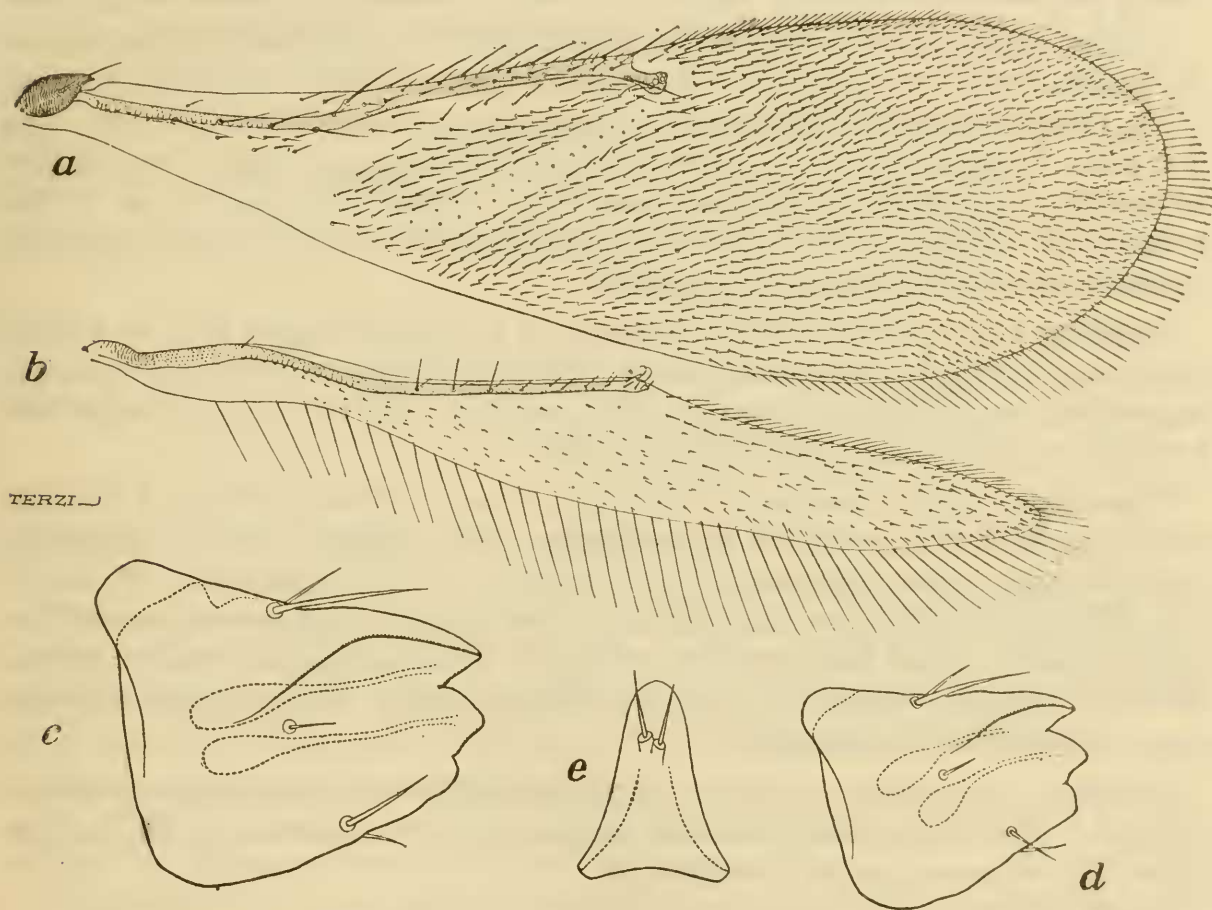


Fig. 5. *Paraphelinus perkinsi*: (a, b) wings of ♀; (c) left mandible of ♀; (d) left mandible of ♂.

P. xiphidii: (e) labrum of ♀.

on vertex and frons (except just between the scapal grooves, where the surface is nearly smooth or finely mamillated) large, raised on vertex and upper frons, but very faint on the face; clypeus smooth. Along each lower orbit are 5-6 bristles and about the same number (strong) superiorly; nearly a dozen smaller bristles between the orbital row and the mid line, on the upper angles of the frons; 5-6 minute bristles inside the genal keel and 9-10 pairs of bristles between and above the toruli; the two clypeal bristles are well above the edge.

Antenna (fig. 2, a): length, .42 mm.; bulla (2 : 1) five-eighths of the scape. The latter narrow (5 : 1), with 6 bristles along the ventral edge, 6-8 on the outer

apical half, about 10 on the dorsal edge, and 20 on the inner surface evenly but sparsely disposed. Surface, especially on the inside, with large-celled little-raised reticulation. Pedicel (25 : 11) scarcely half the scape. Funicle shorter than either club or scape, being about four-fifths of the former or three-fourths of the latter. First funicular (9 : 7) (measuring to the ventral apical angle) equal to one-sixth of the scape. In the same scale, the 2nd and 3rd funicular joints are (12 : 9) and (16 : 13) respectively. The club (45 : 15) is five-sixths of the scape and bears 5-6 sensoria. Bristles of pedicel sparse and evenly set, as on the scape; on the first funicular, round the insertion of the second and along the short dorsal edge are 6-7 bristles, and one on the inner ventral angle; from the 2nd funicular onwards the bristles are more closely set, shorter and fewer; on the club they are numerous and more appressed.

Thorax: pronotum with the bristles weaker than in *xiphidii*, and an extra one on the posterior edge near the middle. Proportions much as in *xiphidii*, scutellum longer (5 : 6), mesophragma to scutellum as 17 : 10, and longer than mid lobe (17 : 15). The four pairs of median bristles are in two nearly parallel lines, converging very slightly anteriorly. In *xiphidii* the first pair immediately behind the pronotum are a little nearer to one another, and the second pair (and sometimes the third) more outwardly displaced, so that the lines are not parallel.

Propodeon: the pre-spiracular propodeal fold is distinctly shown only for a short distance anteriorly, i.e., beside the spiracle. Posteriorly there are only some indistinct longitudinal rugae ending at the side of the petiole. Spiracle relatively larger and broadly oval, with two minute bristles outside.

Wings (figs. 5 a, 6): *Forewings* (3.1), length, .8 mm.; breadth, .26 mm.; broader than in *xiphidii* with two more macrochaetae on the marginal and 1-2 additional minute bristles below the submarginal distally (cf. also the disposition of the 6-7 rows of longer bristles below the marginal to that vein). The bare area beyond the radius smaller. *Hind wings* broader, not eight times as long as broad; length, .68 mm.; breadth, .09 mm.; numerous bristles at apex. Longest hairs of fringe about three-fourths the breadth.

Abdomen: free portion of sheath much as in *xiphidii*, but the long bristles are nearer the apex. Above the sheath the short bristles are very numerous, 14-16, the last (below the setigerous process) being longer.

Length, .85 mm.; alar expanse, 1.8 mm.

♂. Like the female, paler if anything on head and thorax, mandibles apically darker. The fore legs darker than in the female.

Antenna (fig. 4, b): length, .28 mm. *Forewings* (fig. 4, c): length, .54 mm.; breadth, .18 mm. *Hind wings*: length, .44 mm.; breadth, .07 mm.

Paraphelinus tomaspidis, How. (1914).

♀. *Head*: from in front, ciliation of eyes very short and sparse. Clypeal teeth distinct. Between and above the toruli three pairs of bristles, 2-3 bristles inside each genal keel; between the orbits and mid line at the level of the anterior ocellus merely 2-3 bristles. At the same level the frons is one-half the width (just wider than in *xiphidii*).

Antenna (fig. 1, c): length, .3 mm.; bulla over one-third of the scape (4:11). The latter only a little over four times as long as broad (33:8). Bulla + scape longer than pedicel + funicle. Club (nearly 4:1) elongate, three times as long as the last funicular, and exceeding either funicle or scape. Bristles of scape much as in *xiphidii*, except that there are only 3-4 bristles on the anterior apical half, and about 10 posteriorly.

Wings (fig. 6). *Forewings*: length, .5 mm.; breadth, .142 mm.; narrowed basally, narrower than in either *xiphidii* or *perkinsi*, about $3\frac{1}{2}$ times as long as broad. The oblique hairless tract with convergent sides and obscured on about the anterior half, with 10-11 bristles below the submarginal. *Hind wings* (9:1) elongate, narrow and pointed; length, .45 mm.; breadth, .05 mm.; almost as long as the forewings, and nearly bare apically. Longest bristles of fringe exceeding the greatest width.

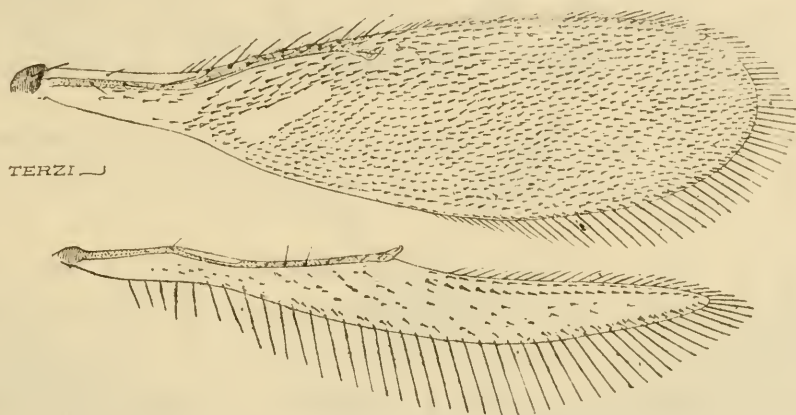


Fig. 6. *P. tomaspidis*, How., ♀, wings.

Abdomen not twice as long as thorax and propodeon. Ovipositor distinctly projecting and exceeding its sheath. The free portion of the latter with two longer ventral bristles, two shorter above, and a number of minute ones at the apex; there are 9 short bristles in a patch above the distal end of the base of the sheath.

Length, .8 mm.; alar expanse, 1.1 mm.

Mr. Williams' example is a little smaller than the genotype, with which however it agrees in having the "hairless line" incomplete.

The following is a comparative description of the legs of the three species here dealt with:—

Fore legs: coxae of *xiphidii* with 10-11 bristles anteriorly (about 15 in *perkinsi*, 7 in *tomaspidis*); femur about 4:1 in *perkinsi*, narrower (5:1) in *tomaspidis*; comb of first tarsal joint 13-14 in *perkinsi*, 9 *tomaspidis*, 10-11 *xiphidii*. *Mid legs*: 4-5 stiff bristles on coxa; first tarsal joint with 3-4 spinose bristles on apical posterior edge. *Hind legs*: coxae bare, but for two bristles above the trochanter and one antero-ventrally; femur (*xiphidii*) anterior subventral row of 6-7 widely spaced bristles and two irregular subdorsal rows of 6-7 each, on apical two-thirds; in *tomaspidis* only 7-8 subdorsal bristles in all, none below one half; tibial comb in all three species with 8-9 spines.

In the chaetotaxy of the legs *xiphidii* and *perkinsi* agree more closely, *tomaspidis* being a barer species. The first tarsal joint of the mid and hind legs is also rather

shorter, the first and second being nearly 5 : 4, as opposed to 4 : 3 in the other species. In the figures of the wings special attention should be given to the shape of both fore and hind pairs and to the distribution of the minute bristles on the basal half. It is noteworthy that in these respects ♀ *tomaspidis* approaches somewhat to ♂ *perkinsi*.

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All the above (except 1) contain explicit references to *Paraphelinus*, but every described yellow or reddish species of *Aphelinus* will ultimately require to be studied before the limits of *Paraphelinus* are understood.
